

Why and How to Connect Energy, Earth and Environmental Education?

Dr. Marilyn A. Brown

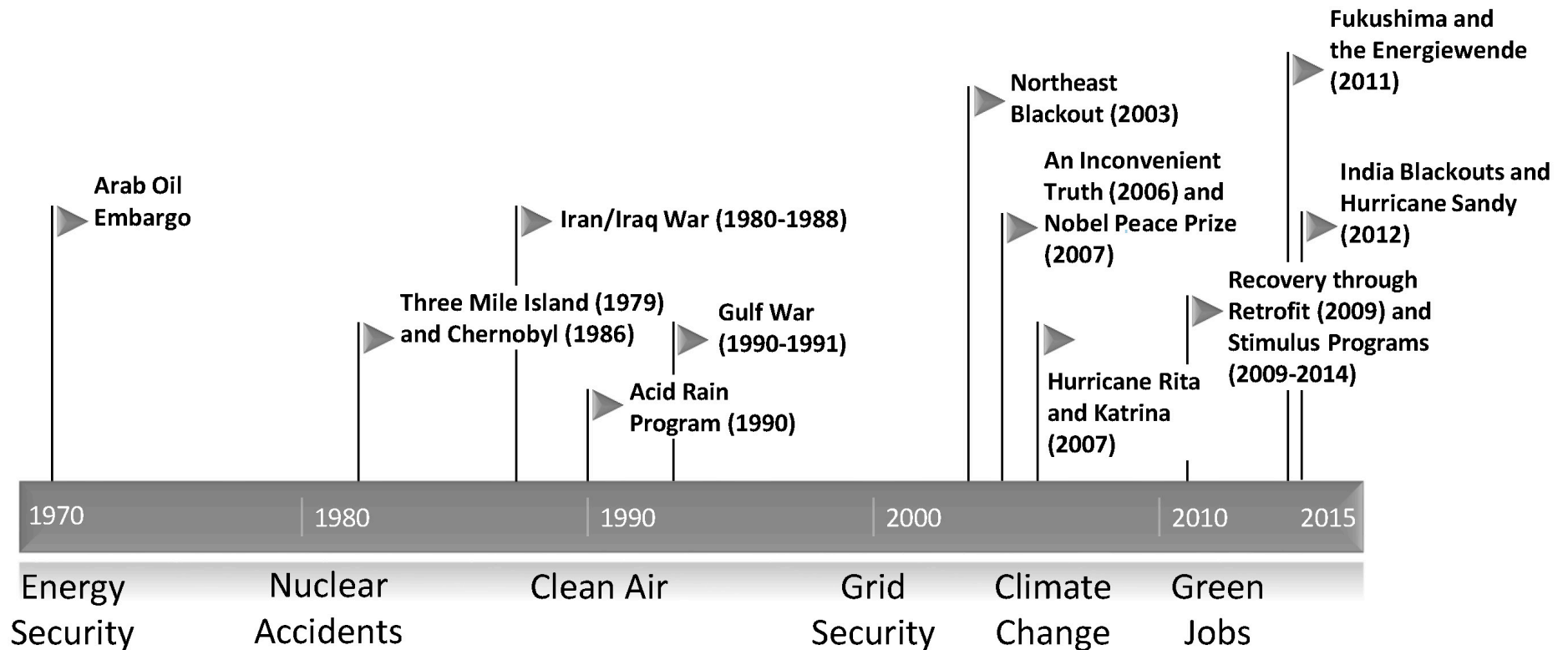
*Regents' & Brook Byers Professor of Sustainable Systems
Georgia Institute of Technology*



E4 Workshop – University of Central Florida
Association for Environmental Studies and Sciences
June 26, 2019

Motivators of Energy Transitions

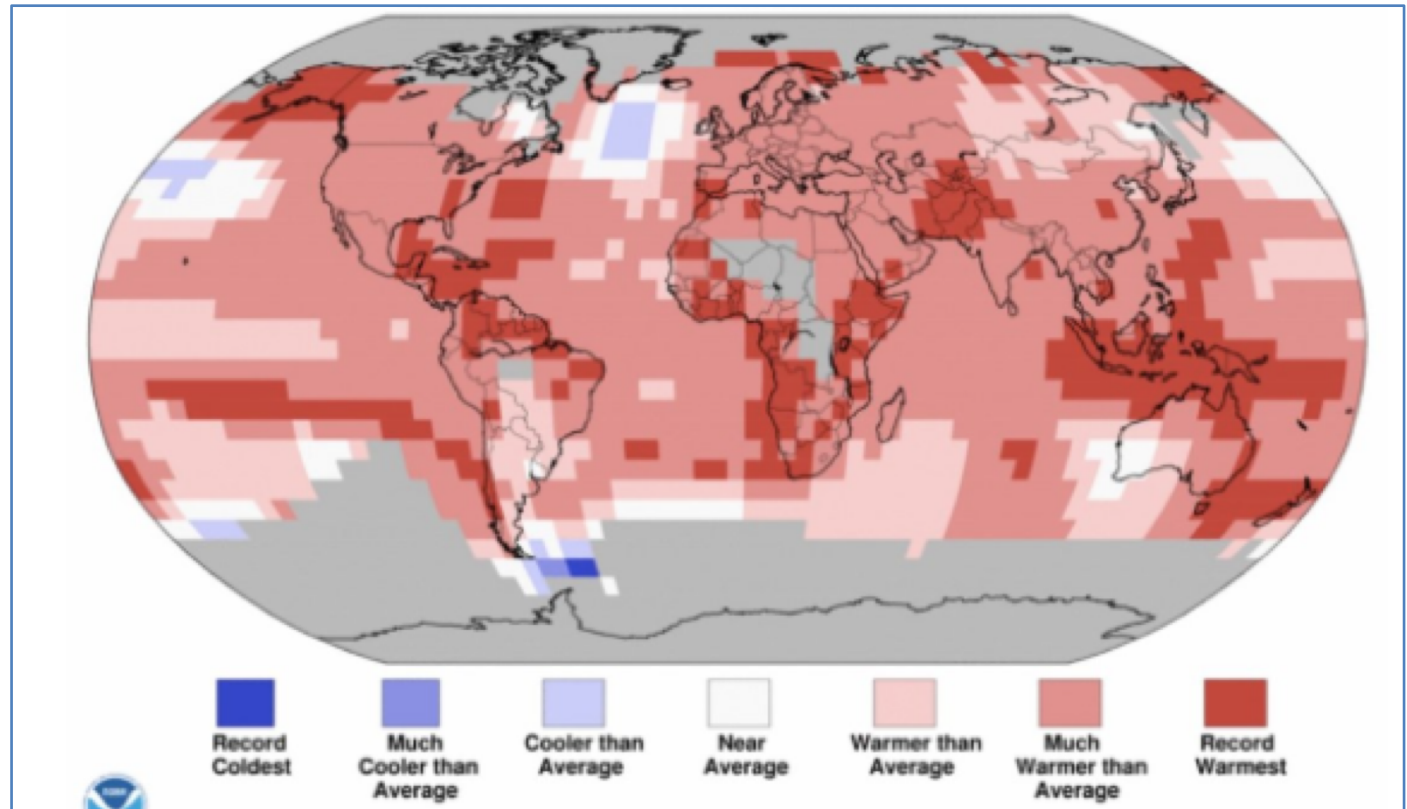
All of these motives are linked to earth and the environment



(Source: Brown and Wang, 2015)

The Energy-Climate Nexus

2016
temperatures
compared to
normal around
the globe
(Source:
NOAA)



2015-18 = Four Hottest Years on record

“...human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming”

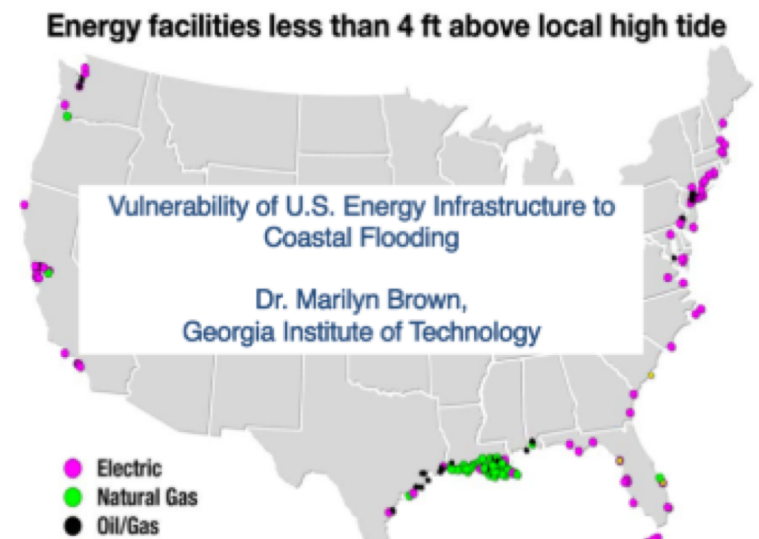
(Source: National Climate Assessment Special Report 2017)

Sea Level: A Rising Concern

The ultimate melting of ice sheets in Greenland and Antarctica could result in sea-level rise of 80 meters.

- ✓ Greenland: 6-7 m
- ✓ West Antarctica: 6-8 m
- ✓ East Antarctic Ice Sheet: 65-67 m

But global warming does not provide enough heat to melt all of the ice sheets suddenly;
∴ there is time for mitigation and adaptation.

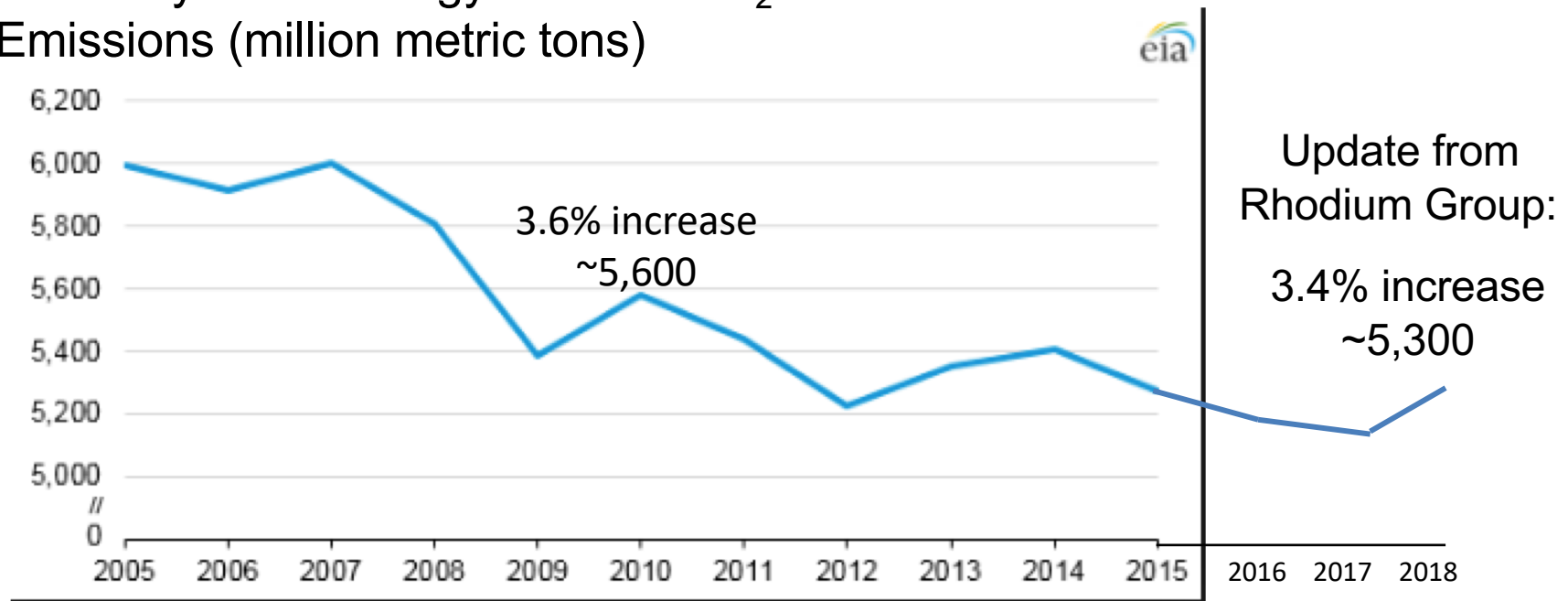


Source: Brown (2018) Geographical Sciences Committee of the National Academies
<https://www.youtube.com/watch?v=91rLXoqreic&t=460s>

How is the U.S. Responding?

After a 10% decline (2005-2015) in CO₂, the U.S. bounced back with an increase of 3.4% in 2018.

Economy-Wide Energy-Related CO₂ Emissions (million metric tons)

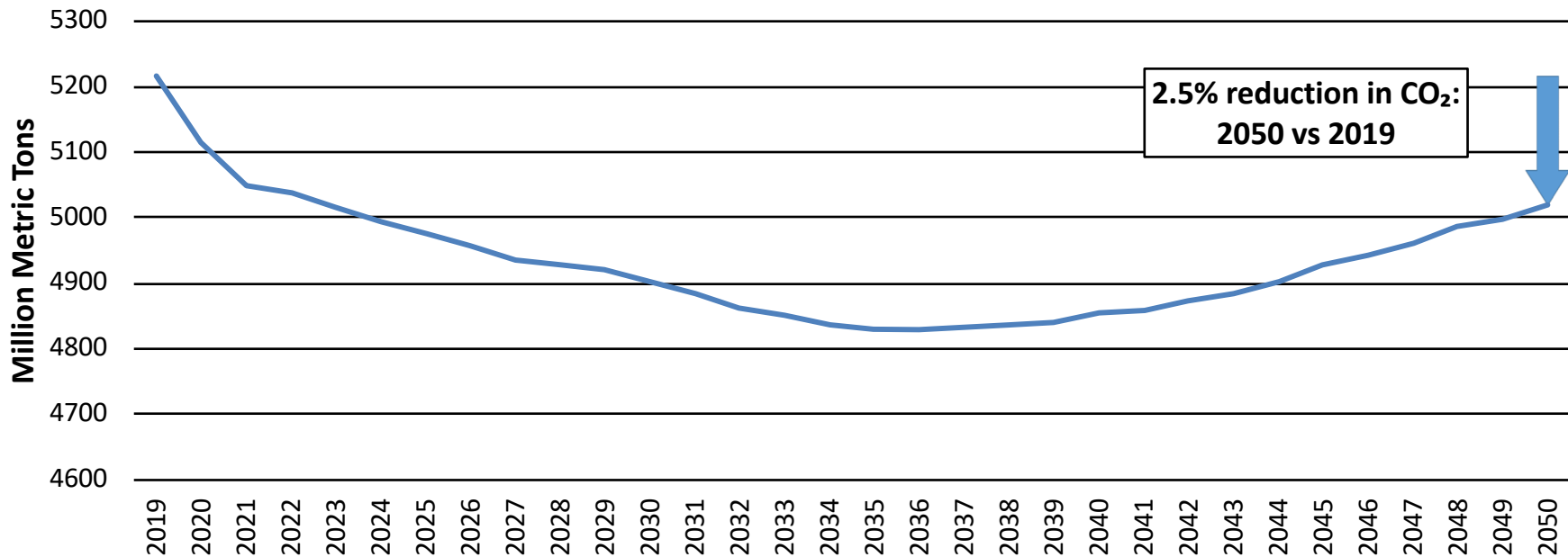


Notable increases in emissions from **natural gas, trucks, and air travel.**

Source for updates: <https://tinyurl.com/yb8ekn8d>

U.S. CO₂ Emissions are Far Off Track for Global Climate Goals

U.S. Total Carbon Dioxide Emission from All Sectors



Global emissions in 2018 set another record = 37 billion (U.S. ~ 5 billion or 14% of total with <5% of population)

“Our Energy Destiny Lies with our Governments”—Fatih Birol, IEA

- One could argue that the necessary science and engineering solutions already exist.
- What’s missing is a deep understanding of consumers, markets and policies – a socio-economic technical perspective.

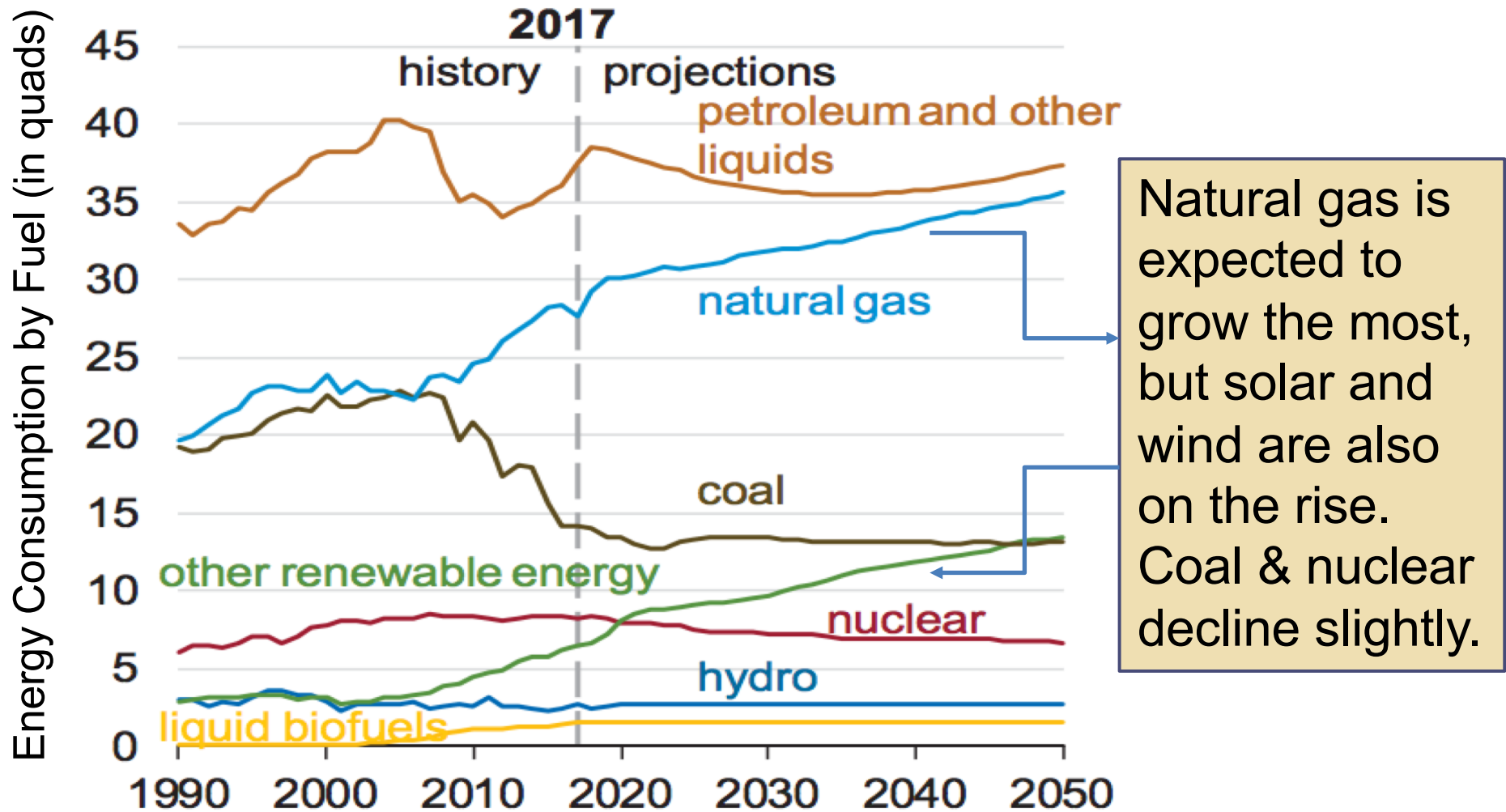
Gigaton Problems Need Gigaton Solutions¹

MING XU
JOHN C. CRITTENDEN*
YONGSHENG CHEN
VALERIE M. THOMAS
DOUGLAS S. NOONAN
REGINALD DESROCHES
MARILYN A. BROWN
STEVE P. FRENCH
Georgia Institute of Technology, Atlanta

Achieving sustainability requires commanding the whole problem, not just iterative efforts that barely strike a moving target.

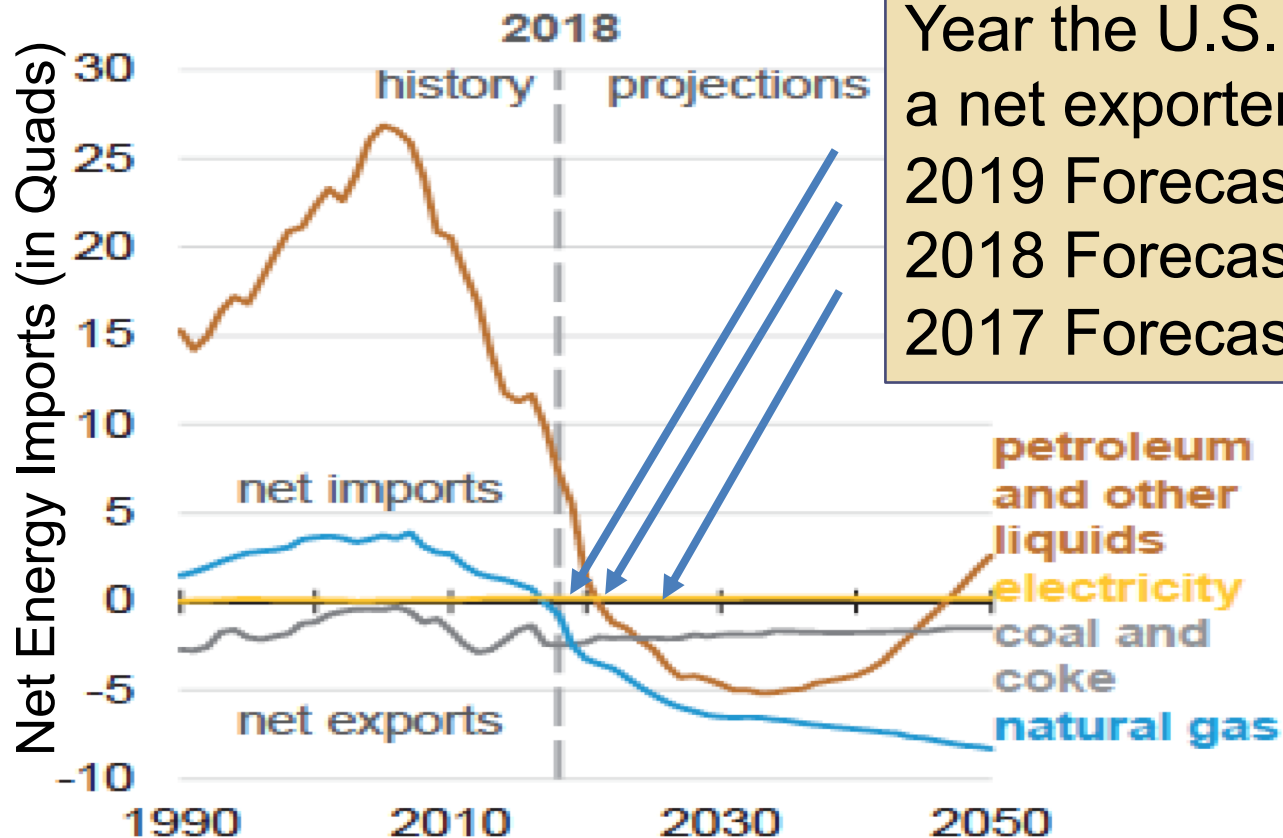


The U.S. Fuel Mix is Evolving



Source: EIA, *Annual Energy Outlook 2018*

The U.S. Will Soon be a Net Energy Exporter (First Time Since 1953)



It is particularly difficult to reset the U.S. energy system, at a time when fossil fuels are so abundant and cheap.

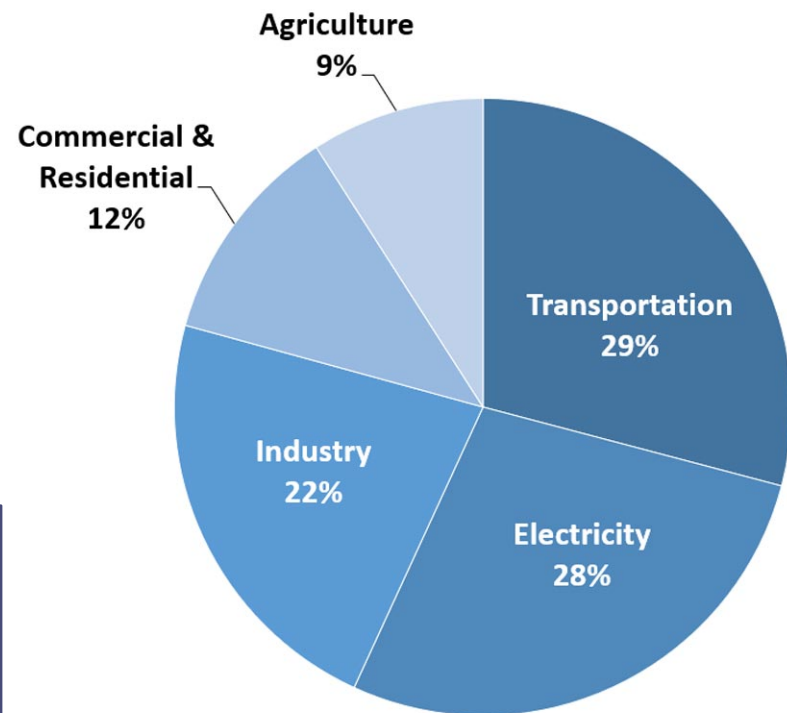
Electricity Systems Offer Low-Cost CO₂ Reduction Potential

Cutting CO₂ emissions in electricity generation is consistently cheaper & easier than in:

- housing, transport
- industry, agriculture

- A **carbon tax** could change behavior and generate revenues for further clean tech investment.

Sources of Greenhouse Gas Emissions in 2017

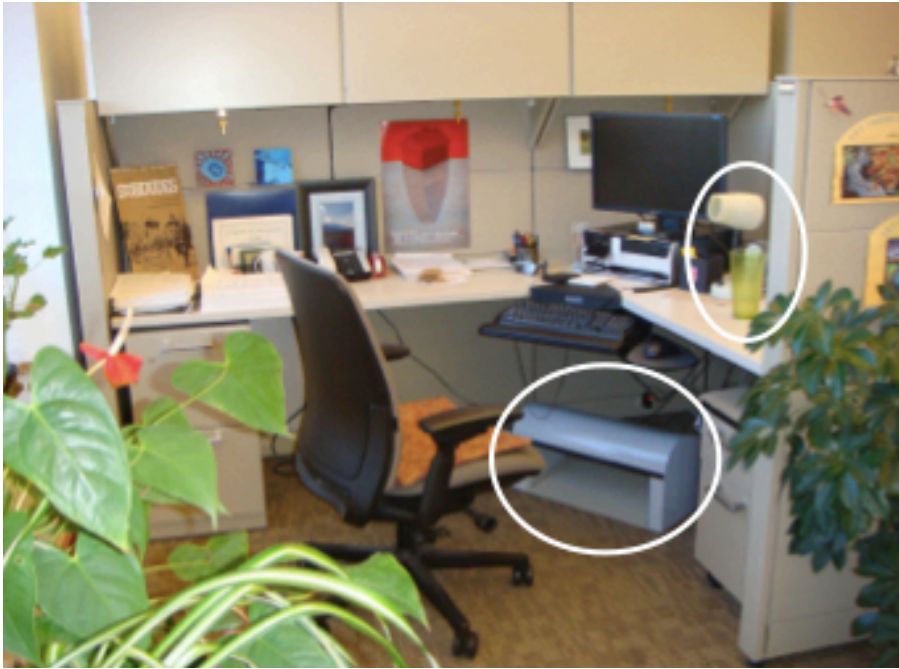


U.S. Environmental Protection Agency (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017

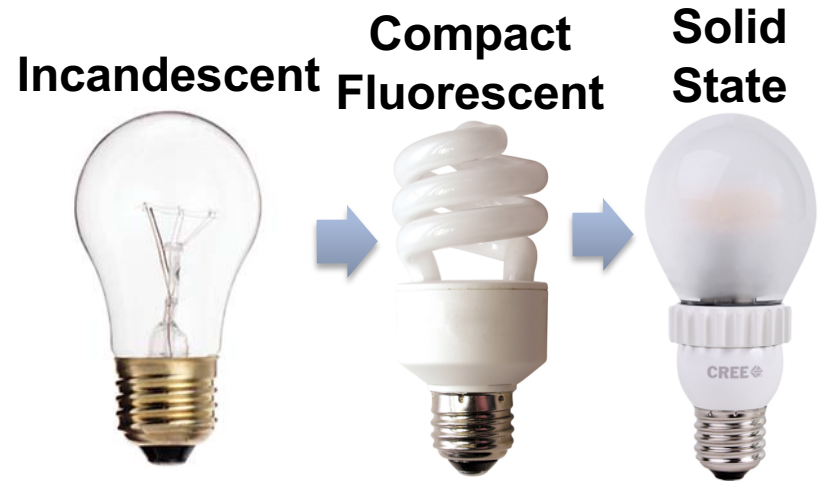
Electricity = 35% of U.S. CO₂ emissions

Carbon Taxes + Energy Efficiency Makes the Transition more Affordable

- **Energy Efficiency** – Increasing the services provided per unit of energy consumed.



Using more efficient equipment.

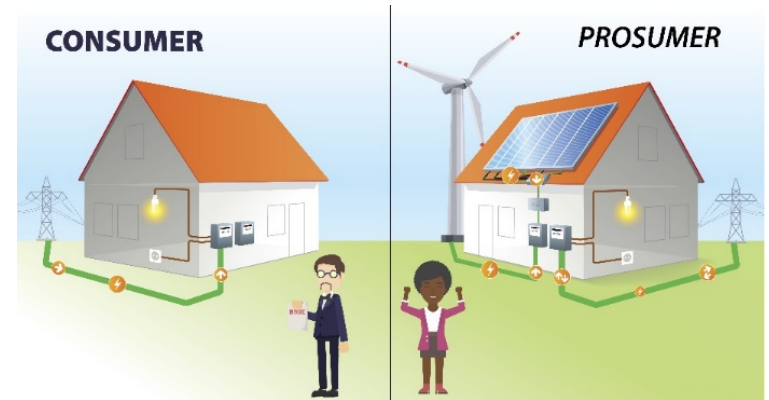


Avoiding ubiquitous lights & cooling.

Watts	60	14	11
Lumens/Watt	14	64	84

We Need Informed Businesses and Consumers

- Pairing storage with rooftop solar and EVs looks promising.
- The technologies are known, but the business models are unclear.



Consumers
are becoming
producers
("Prosumers")



Source: Mateo Jaramillo, Tesla, June 19, 2017

The “Carbon Army” and the Clean Energy Gender Gap

The “carbon army” of millions of U.S. workers in jobs across cities, towns, and rural America--needs to recruit from all ages, races, and genders.

The clean energy gender gap motivated the creation of C3E: the Clean Energy Education and Empowerment initiative.

C3E spun out of the Copenhagen 2009.

I am a founding “Ambassador.”

- Attract more women to rewarding clean energy careers and support their advancement.
- Provide recognition, role models, and advocates for women in clean energy.
- Create networks for women in clean energy to share ideas, views, events, resources, and opportunities.



The Green New Deal: 100% Renewables by 2030

Introduced by Rep. Alexandria Ocasio Cortez (of NY) and Senator Ed Markey (of Mass).



70% of Americans believe environmental protection is more important than growth.

Equivalent to $\sim \$60/\text{tCO}_2$ carbon tax .

Cost of transitioning the grid into 100% renewables $\sim \$700$ billion to $\$1$ trillion annually.

Connecting Energy-Earth-Environmental Education

A growing demand for workers with sustainability training:

- ✓ the shift toward corporate social responsibility
- ✓ the expansion of public programs targeting clean energy and environmental protection
- ✓ an increase in funding and activity by environmental NGOs



Solar PV Walkway @ Arizona State



Campus Energy Monitoring @ Kyushu Univ.

Georgia Tech is Responding

SEEM=Sustainable Energy and Environmental Management

- New professional [MSEEM](#) degree and “Stand-alone” Graduate Certificate (CSEEM): Stackable and flexible (on-line/on-campus).

Georgia Tech

Creating the Next Directories / Maps Search

Climate and Energy Policy Laboratory

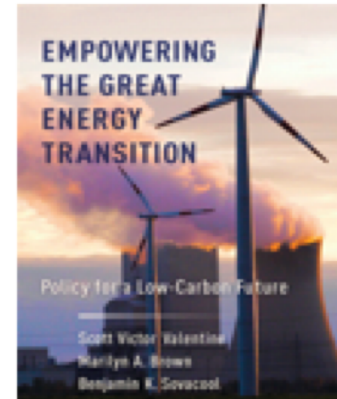
School of Public Policy · Ivan Allen College of Liberal Arts

Home About Us ▾ Programs ▾ Projects ▾ Publications ▾ News Blog People ▾

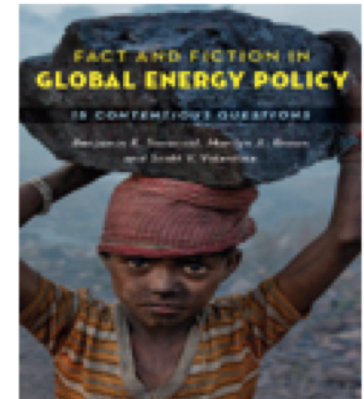
New Sustainability Certificate and Master's Degree at Georgia Tech

For More Information — and some late night reading??

Dr. Marilyn A. Brown,
Regents' and Brook Byers Professor
of Sustainable Systems,
School of Public Policy
Georgia Institute of Technology
Atlanta, GA 30332-0345
mbrown9@gatech.edu
Climate and Energy Policy Lab:
www.cepl.gatech.edu
@Marilyn_Brown1



2019



2016



2015



2013